



United States Air Force 423 SCMS Hydraulic Actuator – Chrome Replacement



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History

- ▶ 423 SCMS Hydraulic Components = Wear & Corrosion Coating
- ▶ Wear & Corrosion Coating = Hexavalent Chromium
- ▶ Hexavalent Chromium = Health Hazard
- ▶ Health Hazard = Government Regulation
- ▶ Government Regulation = Increase Operating Costs
- ▶ Increased Operating Costs = Hexavalent Chromium Alternatives
- ▶ Hexavalent Chromium Alternatives = HCAHC





History cont'd

- ▶ Hard Chrome Alternatives for Hydraulic Components (HCAHC)
- ▶ 2000 through present
- ▶ Phase 1: TO and Drawing Review, Database Development, Test Requirement Development
- ▶ Phase 2: Delta-Qualification and Service Testing
- ▶ Phase 3: Data Evaluation
- ▶ Phase 4: Implementation





Current Status

- ▶ Phase 1: TO and Drawing Review, Database Development, Test Requirement Development (COMPLETE)
 - 100% Complete
 - ▶ 124 Air Force technical orders reviewed
 - ▶ 729 engineering drawings reviewed
 - ▶ 276 chrome plated parts identified with an additional 195 potentially chrome plated parts also identified.
 - ▶ All data collected was input into a Microsoft ACCESS database for collection and search purposes. Hard copy binders of this data were also retained for record.



Current Status

- ▶ Phase 2a: Delta-Qualification
 - Flight Control Actuators
 - ▶ 87 distinct part numbers
 - ▶ 10-12 estimated to require delta-qualification
 - Utility Actuators
 - ▶ 73 distinct part numbers
 - ▶ 10-12 estimated to require delta-qualification
 - Snubbers/Other
 - ▶ 12 distinct part numbers
 - ▶ 3-4 estimated to require delta-qualification





Current Status

- ▶ Phase 2a: Delta-Qualification
 - Flight Control Candidates
 - ▶ B-1 Horizontal Stabilizer (Complete)
 - ▶ B-1 Pitch/Roll SCAS (Complete)
 - ▶ B-1 Spoiler – L5872400 (Complete)
 - ▶ B-1 Spoiler – L5872600 (Complete)
 - ▶ B-1 Lower Rudder (Complete)
 - ▶ B-1 Aft Structural Mode Servocylinder (SMCS) (Complete)
 - ▶ B-1 Forward SMCS (Complete)
 - ▶ C-130 Rudder Booster Actuator (Complete)
 - ▶ A-10 Aileron (Complete)
 - ▶ F-15 Pitch/Roll Channel Assembly (PRCA) (Complete)
 - ▶ T-38 Aileron Actuator (Complete)
 - ▶ F-15 Aileron Rudder Interconnect (On-Going)
 - ▶ A-10 Aileron – Reconfiguration (On-Going)
 - ▶ T-38 Rudder Actuator (On-Going)
 - Utility Candidates
 - ▶ C-130 Ramp Actuator (Complete)
 - ▶ C/KC-135 Main Landing Gear Actuator (Complete)
 - ▶ C/KC-135 Main Landing Gear Door Actuator (Complete)
 - Snubber/Other Candidates
 - ▶ C-135 Aileron Control Surface Snubber (Complete)
 - ▶ KC-135 Ruddevator (Complete)



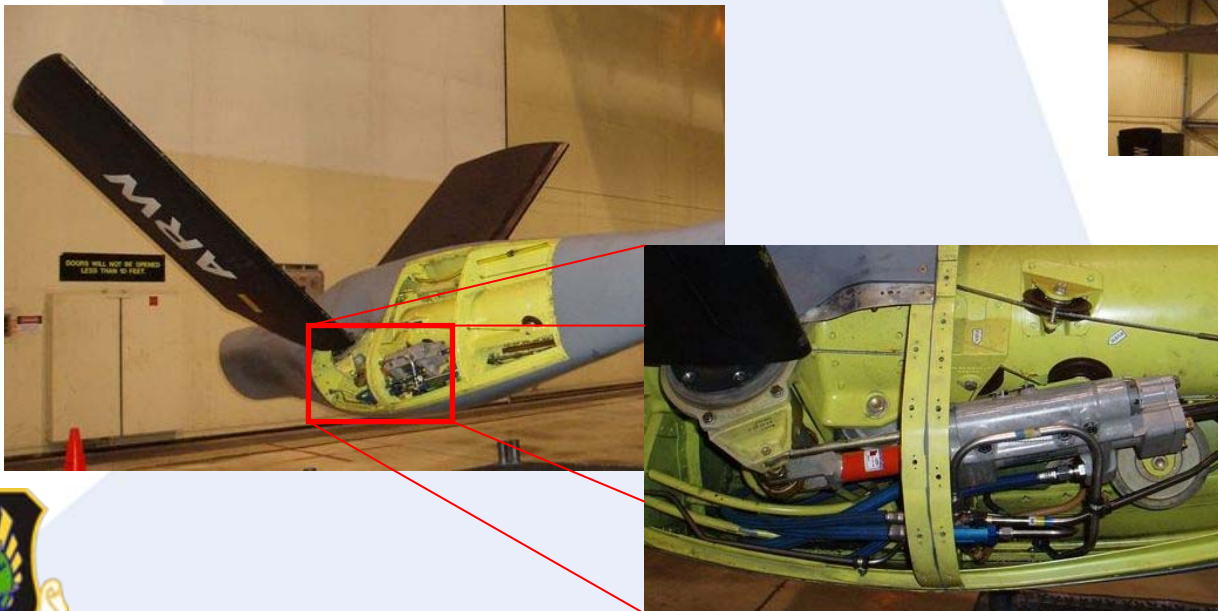
Current Status

- ▶ Phase 2b: Service Testing
 - C-130 and C/KC-135 aircraft stationed in varying climate conditions were chosen for service testing
 - Little Rock AFB (C-130)
 - ▶ Ramp Door Actuator
 - ▶ Aft Cargo Door Actuator
 - ▶ Rudder Booster Actuator
 - ▶ Aileron Booster Actuator
 - Delaware ANG (C-130)
 - ▶ Ramp Door Actuator
 - ▶ Aft Cargo Door Actuator
 - ▶ Rudder Booster Actuator
 - ▶ Elevator Booster Actuator
 - ▶ Service Test Time ~ 12 months



Current Status

- ▶ Phase 2b: Service Testing
 - Grand Forks AFB and MacDill AFB (C/KC-135)
 - ▶ Aileron Snubber Actuator
 - ▶ Ruddevator Actuator
 - ▶ Main Landing Gear Actuator
 - ▶ Main Landing Gear Door Actuator
 - ▶ Service Test Time ~ 18 months





Current Status

► Phase 2b: Service Testing

– Success Criteria

- Some failures occurred due to reasons unrelated to the new coating, and thus those tests were considered incomplete because they did not meet the minimum flight time requirement of the service test plan.
- All actuators that remained on aircraft throughout the service test successfully passed.
- The upgraded seals selected for the C130 rudder delta qualification testing failed the friction requirements of the test, but the elastomeric contact T-seals, currently used on the chrome plated configuration of the actuator were successful in all delta-qualification tests, thus the seals used for all of the C130 flight control actuators during service testing were the elastomeric T-seals. The early seal degradation noted on these seals from the service testing indicates that additional testing on upgraded sealing configurations will be required.



Current Status



► Phase 2b: Service Testing

C-130	Part Number	Install Location/ Tail Number	Date installed	Date removed	Findings	Pass/Fail
Ramp ID # 1	370750-1	Little Rock AFB	6-Jun-06	N/A	Actuator installed on aircraft deployed >May 08	Unknown
H503021677		31037				
Ramp ID # 2	370750-1	Delaware ANG	20-Jun-06	?	Completed test	Pass
R4951		84000209			Passed posttest ATP, Inspection revealed no damage to coating	
Aft Cargo Door ID # 3	370749-1	Little Rock AFB	6-Jun-06	N/A	Actuator installed on aircraft deployed >May 08	Unknown
H503020719		31037				
Aft Cargo Door ID # 4	370749-1	Delaware ANG	20-Jun-06	?	Completed test	Pass
H503020583		84000209			Passed posttest ATP, Inspection revealed no damage to coating	
Rudder Booster ID # 5	5C5792-1	Little Rock AFB	6-Jun-06	30-Aug-07	Removed due to chattering during operation	Unknown
H503020778		31037			Actuator not received for posttest inspection, current whereabouts are unknown	
Rudder Booster ID # 6	5C5792-1	Delaware ANG	20-Jun-06	17-Nov-06	Failure unrelated to coating	Incomplete*
H503020781		84000209			Removed due to binding when coming off hard over, Inspection revealed piston head sticking in snubber IDs, metal debris, early seal wear	
Aileron Booster ID # 7	5C5791	Little Rock AFB	6-Jun-06	5-Feb-07	Failure unrelated to coating	Incomplete*
PRJYF55999		31037			Removed due to leakage, Inspection revealed crown wear on T-seal	
Elevator Booster ID # 10	5C5803	Delaware ANG	26-Jun-06	25-Sep-07	Failure unrelated to coating	Pass*
H503020616		84000209			Removed due to leakage, Inspection revealed very heavy crown wear on T-seal	

* Indicates the actuator successfully passed the testing requirements, but did not meet the 1 year service test schedule requirement and/or additional seal testing is necessary





Current Status

► Phase 2b: Service Testing

C-135	Part Number	Install Location/ Tail Number	Date installed	Date removed	Findings	Pass/Fail
Snubber ID # 11	5-88763-10	Grand Forks AFB	14-Feb-06	?	Completed test	Pass
DMI-138		91502			Passed posttest ATP, Inspection revealed no damage to coating	
Snubber ID # 12	5-88763-10	MacDill AFB	20-Mar-06	?	Reason for failure/removal unknown	Unknown
DMI-043		62-3548			Inspected aircraft at PDM, 9-26-07, snubber not there, Current whereabouts are unknown	
Ruddevator ID # 13	65-6750-501	Grand Forks AFB	14-Feb-06	?	Failure unrelated to coating	Pass**
345		91502			Showed up for repair at Hill, Mar. 12, 2007, Actuator failed posttest ATP deadband test, passed all other portions of ATP	
Ruddevator ID # 14	65-6750-501	MacDill AFB	20-Mar-06	15-Jul-07	Failure unrelated to coating	Pass
454		62-3548			Failed ATP due to high input force required on slide and sleeve assembly	
MLG ID # 15	5-84046-6	Grand Forks AFB	14-Feb-06	7-Oct-06	Failure unrelated to coating	Pass*
H503020400		91502			Removed from aircraft due to exterior rust and missing roller bearings, actuator passed posttest ATP, Inspection revealed no damage to coating	
MLG ID # 16	5-84046-6	MacDill AFB	20-Mar-06	24-Mar-08	Completed test	Pass
H50300100		62-3548			Passed posttest ATP, Inspection revealed no damage to coating	
MLG Door ID # 17	5-84045-9	Grand Forks AFB	14-Feb-06	?	Current whereabouts are unknown	Unknown
9760		91502				
MLG Door ID # 18	5-84045-9	MacDill AFB	20-Mar-06	24-Mar-08	Completed test	Pass
1669		62-3548			Passed posttest ATP, Inspection revealed no damage to coating	

* Indicates the actuator successfully passed the testing requirements, but did not meet the 1 year service test schedule requirement

** The removal date from aircraft will determine if the actuator met the 1 year service test schedule requirement.



Current Status

- ▶ Phase 3: Data Evaluation
 - All delta-qualification and service test data has been reviewed, analyzed, and summarized in final reports for each individual actuator.





Current Status

- ▶ Phase 4: Implementation
 - This phase has been initiated through the development and submittal of repair figures and updated seal information for technical order (TO) applications for all identified actuators.
 - Implementation strategy under discussion with AF internal Technical Review Boards (TRBs), OEMs, SPOs (e.g., configuration issues, part numbers, etc.)





Current Status - Summary

- ▶ Phase 1: TO and Drawing Review, Database Development, Test Requirement Development – COMPLETE
- ▶ Phase 2a: Delta-Qualification and Service Testing
 - 11 Flight Control Candidates Complete / 3 On-Going
 - 3 Utility Candidates Complete
 - 2 Snubber/Other Candidates Complete
- ▶ Phase 2b: Service Testing
 - 3 Flight Control Candidates Complete
 - 4 Utility Candidates Complete
 - 2 Snubber/Other Candidates Complete
- ▶ Phase 3: Data Evaluation
 - Complete on all units that have completed phase 2
- ▶ Phase 4: Implementation
 - Initiated





Future

- ▶ Build & Prioritize a plan to include:
 - Implementation of those components that have been proven
 - ▶ Provisioning
 - ▶ TO integration
 - ▶ Approve sources of overhaul / repair
 - Complete Similarity Analysis
 - Continue with Delta-Qualification (as needed)



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